SECTION 28.0 | WELDING AND CUTTING

This program has been designed for the purpose of ensuring a safe work environment during the performance of welding, cutting and hot work operations. The procedures set forth in this program apply to all employees who are directly involved, or assist in, welding, cutting and hot work tasks. This program covers Hindsight Electric, LLC employees and contractors and must be used on Hindsight Electric, LLC owned premises. When off site, the site operator's program takes precedence unless it is less stringent than Hindsight Electric, LLC's program.

- Defective equipment or other safety hazards should be reported immediately. Defective equipment must be pulled from service until its safety has been validated. Repairs may only be made by qualified, authorized personnel.
- If objects to be cut or welded are immovable and if all the present fire hazards cannot be cleared, the object must be removed or guards must be used to restrain the heat, slag, and sparks, and to protect the immovable fire hazards.

28.1 | Definitions

1. **Welding and Hot Work Procedures** – activities that have the potential to cause fires or explosions due to sparks, molten slag, fire, or other hot material.
2. **Hot Work Examples** – welding, cutting, soldering, grinding, brazing, thawing pipes and using electric tools in hazardous areas.
3. **Hazards** – dangerous conditions that include, but are not limited to, the following: skin burns, fires, welding "blindness", explosions, fumes, and smoke.
4. **Special Hazard Occupancies** – areas where the following potential fire hazards are present: gasses, flammable liquids, accumulation of dust, rubber, plastics, and paper products.

28.2 | Key Responsibilities

Managers and Supervisors

1. Establish if the site is safe for cutting and welding operations,
2. Determine the safe areas for performing cutting and welding operations,
3. Supply training for all employees and contractors whose job duties include performing operations that produce heat, spark, or flames, such as welding, grinding or brazing,
4. Create and implement effective hot work procedures,
5. Provide appropriate personal protective equipment (PPE) for hot work,
6. Supply safe, properly working equipment for hot work,
7. Make certain that all PPE and hot work equipment are in safe working order,
8. Oversee all hot work operations,
9. Inspect the hot work area before work begins,
10. Permit only trained and authorized employees and contractors to conduct hot work,
11. Make sure permits are obtained for all hot work performed outside of authorized work areas.

Employees

1. Inspect all hot work equipment before use,
2. Use applicable hot work PPE,
3. Follow all established hot work procedures,
4. Report unsafe conditions or defective equipment immediately.

27.3 | General Guidelines

1. Equipment operators must report equipment defects and discontinue use until it has been repaired or replaced.
2. Written permits must be obtained before hot work is performed. The work area must be inspected, and authorization obtained via written permit before proceeding with cutting or welding operations.
3. Whenever possible, combustibles should be placed a minimum of 35 feet from the work area. When relocation of combustibles is not practicable, they must be protected via the following means to prevent

accidental ignition of the material: flameproof covers, wetting the material, shielding with met, guards or curtains.

4. Augers, conveyor systems, and ducts that have the potential to carry sparks to distant combustibles must be protected or turned off.
5. If welding or cutting is performed near ceilings, walls, partitions, or openings in the floor (such as grating and manholes), fire-resistant guards or shields must be used to avoid ignition.
6. When welding is conducted on metal ceilings, walls, partitions or flooring, care must be taken to prevent the ignition of combustible materials on the other side due to radiation or conduction of heat. When combustibles on the opposite side cannot be moved, a fire watch person will be provided on the opposite side to monitor the work.
7. Welding on a metal partition, ceiling, wall, or flooring made of combustible sandwich panels is strictly prohibited.
8. Welding and cutting operations may not be conducted when pipes or other metal to be welded are in contact with combustible walls, floors, partitions, ceilings, or roofs closely enough to cause ignition by combustion.
9. If welding cannot be conducted safely, the welding and cutting shall not be performed.
10. Cutting or welding must not be performed under the following circumstances:
    - Unauthorized areas,
    - In the presence of flammable or explosive atmospheres,
    - In sprinklered buildings where the sprinklers are impaired,
    - In areas near large quantities of stored combustible materials,
    - In locations where the accumulation of dust is more than 1/16th of an inch within a 35 feet perimeter of the area where hot work is to be conducted. All dust accumulation must be cleared before welding or hot work begins.
11. If welding or cutting is performed in an area where fires might develop, or if any of the conditions listed above cannot be satisfied, a fire watch will be provided.
    - The fire watch must be present during welding procedures and for at least 30 minutes (an half hour) after welding is completed,
    - The fire watch must be properly trained in the use of fire extinguishers and must have knowledge of the facility's alarm system,
    - The fire watch will have the appropriate fire extinguishers at the ready during the procedure,
    - Appropriate fire extinguishers will be supplied and available for immediate use,
    - Hot work permits must be obtained for all welding or cutting procedures performed outside designated welding areas.

Fire Prevention Measures

1. Designated welding areas will be established according to the following specifications:
    - Fire extinguishers shall be made readily available at all times during welding & cutting operations,
    - Floors must be swept and cleared of combustible materials within 35 feet of the work area,
    - Flammable and combustible materials must be placed 35 feet or more from the designated work area,
    - Adequate ventilation must be provided to supply 20 air changes per hour,
    - At least one 10 lb. dry chemical fire extinguisher must be within reach of the 35 feet of the work area,
    - Welding curtains, noncombustible walls or other protective dividers will be supplied to confine slag and sparks to the combustible-free area.
2. Requirements for welding outside the designated area
    - A hot work permit must be obtained prior to beginning welding operations,
    - Portable welding curtains or shield must be utilized for the protection of other workers in the welding area,
    - Plastic materials must be protected by welding tarps during the welding operations,
    - Respiratory protection must be used unless adequate airflow away from the welder and others present in the work area can be set up and maintained,

- A fire watch must be present during all hot work operations.

3. After the completion of welding operations, the welder must mark the metal as hot or warn other workers of the fact in some way.

Confined Spaces

A confined space is defined as a space that is large enough that an employee can enter full-bodied into the area to perform the assigned work, has limited means for entering and exiting the space (e.g., vessels, coolers, tanks, hoppers, storage bins, vaults and pits), and Is not intended for continuous occupancy. Refer to the Confined Space Section 10.0 before beginning any cutting, welding or brazing operations that meet the requirements of a confined space.

1. Adequate ventilation is required to work in a confined space.
2. When welding or cutting in a confined space, the gas cylinders and welding machines must be left outside the confined space. Prior to beginning work, heavy portable equipment on wheels must be stabilized to prevent accidental movement.
3. When welding operations are performed in a confined space that must be entered through a manhole or similar opening, a quick means of exit must be provided to protect the welder in case of an emergency.
4. When using safety belts for this purpose, the belt must be attached to the welder's body in such a way that it does not get jammed in the opening,
5. An attendant will be stationed outside the opening to observe the welder and put the preplanned rescue procedures into effect, if needed.
6. When arc welding procedures cease for a substantial amount of time (e.g., during lunch or overnight), the electrodes must be removed from the holders. The holders must be carefully placed to avoid accident contact. The machine must be disconnected from its power source.
7. Improperly closed valves pose a risk of allowing the escape of gas through leaks. In order to eliminate this risk, when gas welding or cuffing ceases for a substantial period of time, torch valves must be closed; the torch's fuel-gas and oxygen supply must be shut off along some point outside the confined area. If possible, remove the torch and hose from the confined space.
8. When welding must be performed in an area with screens on all sides, the screens must be arranged to avoid restriction of ventilation. Preferably, screens should be mounted approximately two (2) feet above the floor unless the work is performed at a level so low that the screens must be lower in order to protect nearby workers.
9. Fixed enclosures must have a top and at least two sides to surround the welding or cutting operations. A sufficient airflow must be in place to maintain a velocity away from the welder of 100 linear feet (30 m) per minute or greater.
10. When welding and cutting in confined spaces, adequate ventilation must be provided to avoid the accumulation of toxic materials and to avoid possible oxygen deficiencies. This is to protect the welder as well as helpers and other employees in the immediate area. When air is withdrawn, it will be replaced with clean air.
11. When circumstances will not allow for such ventilation, airline respirators or hose masks will be provided. These are approved for this purpose by the National Institute for Occupational Safety and Health (NIOSH). In areas where a threat to life is present, a positive pressure, full-face, self-contained breathing apparatus, or a combination of a full-face piece, positive pressure supplied-air respirator with an auxiliary, self-contained air supply approved by NIOSH must be used.
12. When welding operations are conducted in confined spaces where it is necessary for welders and their helpers to provide hose masks, hose masks with blowers or self-contained breathing apparatuses, an additional worker will be situated outside the confined space to monitor the safety of those in the confined work area.

Fumes, Gasses, and Dust

Toxic fumes may be produced during some welding procedures; these fumes may require extraction. An assessment of the work to be conducted must be completed before beginning the work. Fumes usually contain small particles of the material being welded; these fumes can have a severe effect on the respiratory system. Welding of materials that have the potential to produce dangerous fumes require proper ventilation and/or the use of respiratory protection. This also applies when inert-gas metal-arc welding or oxygen-cutting stainless steel. These materials include:

- Lead base metals
- Zinc
- Mercury
- Cadmium
- Fluorides
- Beryllium
- Exotic metals or paints not otherwise listed

Employees must refer to the Respiratory Protection Program to evaluate which type of respiratory protection should be used during welding procedures. Welding and cutting operations must be adequately ventilated to avoid the accumulation of toxic materials for the safety of the welder, helpers, and other personnel in the work area.

Cleaning Compounds

Because cleaning materials are often toxic or flammable, precautions must be taken, and the manufacturer's instructions must be followed.

1. Cleaning and degreasing that involves chlorinated hydrocarbons must be performed in locations where no vapors from these processes can reach or be drawn into the atmosphere surrounding the welding operations,
2. Trichloroethylene and perchloroethylene must also be kept out of atmospheres that may be penetrated by UV radiation of gas-shielding welding procedures.
3. Mechanical ventilation must be used when oxygen cutting procedures using a chemical flux, iron powder or gas shielded arc cutting for stainless steel. This ventilation must adequately remove the fumes generated by these procedures.

Cylinders

DOT-approved compressed gas cylinders are clearly marked near the cylinder's shoulder and identify the chemical or trade name of the gas contained inside.

1. Compressed gas cylinders must be ANSI B57.1-1965 compliant,
2. Compressed gas cylinders must always be secured in an upright position except when it is not practicable, for short periods of time, when carrying or hoisting the cylinder.
3. Cylinders must be kept away from heat sources, radiators and piping systems used in grounding. Cylinders and their valves, including couplings and regulators, must be free from oily or greasy residue. Do not handle cylinders with gloves or rags that may contain oil or grease residue.
4. Stored oxygen cylinders must be located a minimum of 20 feet from fuel gas cylinders and other combustible materials, including grease and oil. Alternately, stored oxygen cylinders may be separated from these hazards by a noncombustible barrier that is at least five (5) feet high and has a fire safety rating of at least 30 minutes. Valves on empty cylinders must be closed. Protective caps should always be placed on valves, hand-tight, except when the cylinder is connected for use.
5. Cylinders must never be kept in unventilated enclosures such as cupboards and lockers.
6. Storage of fuel gas cylinders inside buildings is limited to a total capacity of 2000 cubic feet (300 lbs.) of liquefied petroleum gas, except those cylinders in use or attached and ready for use.
7. Acetylene cylinders should be stored with the valve end up.
8. Appropriate storage spaces will be provided for cylinders to ensure they are not knocked over, damaged by falling objects or susceptible to tampering by unauthorized persons.
    - Protection from back flow will be accomplished via an approved device that prevents fuel from flowing into the oxygen system and oxygen from flowing into the fuel-gas system,
    - Flashback protection will be provided via an approved device that prevents flame from entering the fuel-gas system,
    - Backpressure protection will be provided via an approved pressure-relief device set at the recommended pressure.

9. The transportation of gas cylinders must follow these requirements:
    - Valve caps must be installed,
    - Cylinders must be secured,
    - Cylinders must not be lifted by the valve protection caps. The regulators must be removed,
    - Cylinders should not be dropped or otherwise allowed to strike each other,
    - Regulators that are removed must be carried in the vehicle's cab,
    - Cylinders are not to be tampered with, nor should any person attempt to repair a cylinder,
    - Cylinders must be carefully handled at all times. Knocks, falls, or rough handling may damage the cylinder, its valve or safety device, resulting in leakage.
10. Safety devices must never be tampered with.

28.4 | Arc Welding and Cutting

1. Personnel are required to be qualified or trained prior to operating, maintaining, or installing welding equipment.
2. All workers instructed to operate or perform maintenance on equipment must be familiar with the following Requirement for Electric Arc Welding Standards:
    a. 29 CFR 1910.254
    b. 29 CFR 1910.252 (a) (b) (c)
    c. American Welding Society Standard A6-1-1966 if gas shield arc welding is performed.
3. Electrical welding equipment will be selected for safe operation that comply with the above standards,
4. Arc welding equipment must be able to withstand exposure to corrosive fumes, excessive oil vapor and humidity, flammable gasses, unusual vibration or shock, excessive dust and seacoast or shipboard conditions,
5. Arc welding equipment must be operated at the voltage recommended in the manufacturer's recommendations,
6. Leads must be inspected regularly and replaced if splices are unprotected or if insulation is broken,
7. Electrical tape cannot be used to repair leads,
8. When using an arc welder, all ground connections must be checked to ensure the mechanical strength and electrical capabilities are adequate for the required current.
9. A disconnecting switch or controller and an overcurrent protection will be provided near each welding machine.
10. Direct current machines are required to be connected with the same polarity. Alternating current machines must be connected to the same phase and polarity of the supply circuit.
    a. Electrode holders must be located to avoid contact with persons, conducting objects or fuel from compressed gas tanks,
    b. Cables with splices within 10 feet of the holder must not be used.
11. If objects to be cut or welded are immovable and if all the present fire hazards cannot be cleared, guards must be used to restrain the heat, slag, and sparks, and to protect the immovable fire hazards.

28.5 | Resistance Welding

1. Only personnel trained in the operation, maintenance and installation of welding equipment may do so.
2. Shields, guarding, grounding, voltage, and interlocks must conform to the manufacturer's recommendations,
3. Protective measures such as ventilation, shields and flash guarding must be provided to control metal fumes, flashes, and toxic elements.
4. If the object to be welded or cut is immovable, all fire hazards should be moved.
5. Arc welding in wet or high humidity conditions requires special protection against electric shock and will be provided.
6. Workers and the public must be protected against injury from the blowing out of closures or other pressure restraining devices when pipelines are being pressure tested,
7. Protection will be provided against the discharge of loose dirt that may have become trapped in the pipe.
8. Welding construction of transmission pipelines must be performed according to the Standard for Welding Pipelines and Related Facilities, API St. 1104-1998.

28.6 | Oxygen Fuel Gas Welding and Cutting

1. Only approved implements such as regulators, torches, setting generators, pressure-reducing valves and manifolds will be used:
    - Mixtures of oxygen or air and fuel gasses may be explosive and should be avoided whenever possible,
    - Hoses and their connections must adhere to the applicable standards of the Compressed Gas Association and Rubber Manufacturers Association,
    - Workers overseeing the oxygen or fuel-gas supply equipment and generators must be trained and deemed competent before being left in a supervisory position.
2. If the object to be welded is immovable, all fire hazards must be removed from the work area.

Fire Watch Requirements

1. A fire watch will be provided under the following conditions when welding, soldering, cutting, or brazing is conducted near combustible materials or locations where fire hazards may develop:
    - Areas where fires that are not minor may develop,
    - Combustible materials are within 35 feet or less to the area where hot work is conducted,
    - Combustibles are 35 feet or more from the work area, but are easily set aflame,
    - Wall or floor openings are present within 35 feet or less of exposed combustible materials,
    - Combustible materials are next to the opposite side of metal roofs, ceilings, or partitions.
2. Fire watch personnel must stay at least 30 minutes after welding or cutting operations have ceased. All fire watchers must have fire extinguishers at the ready.

28.7 | Personal Protection Equipment (PPE)

PPE must be of proper fit, adequate for the task at hand and readily available. Defective or damaged PPE must be discarded / replaced or repaired in order to ensure maximum effectiveness. The following safe work practices shall be followed regarding welding and PPE:

1. Helmets and hand shields must be made of a material that insulates from heat and electricity. Helmets, goggles, and shields must be capable of withstanding sterilization and should not be easily flammable. Helmets and hand shields must be in place to protect the face, ears, and neck from direct radiant energy from the arc.
2. Helmets must have filter plates and cover plates that allow for easy removal. All parts must be constructed of materials that are not easily susceptible to corrosion and do not discolor the skin.
3. Goggles must be ventilated to avoid fogging of the lenses. All glass for goggle lenses must be tempered, free from scratches, waves, air bubbles and other imperfections. The front and rear surfaces of lenses and windows must be parallel and smooth; lenses used to provide vision corrections are the only exception to this. Lenses are required to have a permanent, distinct marking to easily identify their shade and source.
4. When high yellow light is produced in gas welding or oxygen cutting procedures, it is preferable to use a filter or lens capable of absorbing the yellow or sodium line in the visible light. All plates and filter lenses must meet the ANSI Z87.1 – 1968 – American National standard for eye and face protection for transmission of radiant energy.
5. Appropriate clothing and hand protection must be worn to protect the skin from welding hazards.